

# Availability of olfactory bulb: experience from a British Brain Bank

Disponibilidade de bulbos olfatórios em um banco de cérebro britânico: a experiência do Queen Square Brain Bank

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## ABSTRACT

The olfactory bulb and tract (OB/OT) are among the earliest structures in the brain to undergo pathological changes in many neurodegenerative conditions. The availability of OB/OT samples from brain specimens in brain banks therefore assumes importance. We collected data from 5 years (2006-2010) regarding the presence or absence of OB/OT material in cases received by the Queen Square Brain Bank (QSBB) for Neurological Disorders, UCL Institute of Neurology, UK, to estimate availability of OB/OT material at the brain bank and also to look for possible associations. Of the 438 cases received, 320 had complete data regarding OB/OT and 29.4% of these had OB/OT in at least one half of the specimen. Unavailability of OB/OT was associated with larger post-mortem delays ( $p < 0.001$ ), suggesting that the delay might render the tissue more friable and hence lead to its loss. Brains from female donors also tended to have a higher availability in our samples.

**Key words:** olfactory bulb, olfactory tract, brain bank, autopsy, Parkinson's disease.

## RESUMO

O bulbo e o trato olfatórios (OB/OT) são algumas das estruturas cerebrais mais sensíveis a neurodegeneração. A disponibilidade deste material para estudos neuropatológicos em bancos de cérebro tem, portanto, grande relevância. Coletamos dados referentes a 5 anos (2006-2010) a respeito da presença ou ausência de OB/OT no Queen Square Brain Bank (QSBB) for Neurological Disorders, parte do UCL Institute of Neurology, Reino Unido, para estimar a disponibilidade deste material em um banco de cérebro, e também para estudar fatores que influenciam essa disponibilidade. Dos 438 casos recebidos, encontramos dados referentes a presença ou ausência de OB/OT em 320, dos quais 29,4% possuíam OB/OT em pelo menos um lado. A indisponibilidade de OB/OT foi associada a maior intervalo entre a morte e a autópsia ( $p < 0.001$ ), sugerindo que o atraso pode deixar o material mais friável, levando a perda durante a coleta. Cérebros de doadoras femininas apresentaram maior disponibilidade de OB/OT em nossa amostra.

**Palavras-Chave:** bulbo olfatório, trato olfatório, banco de cérebro, autópsia, doença de Parkinson.

Olfactory deficits are now considered a key symptom of neurodegenerative conditions with a high prevalence in several neurodegenerative diseases. Numerous studies on the pathophysiologic changes in the olfactory bulb and tract (OB/OT) associated with Parkinson's disease (PD), progressive supranuclear palsy, multiple system atrophy and Alzheimer's disease, among other conditions, support this<sup>1</sup>.

Braak et al., in their seminal paper on the pathological staging of PD had demonstrated that the OB is among the earliest structures in the brain to be affected by Lewy body pathology<sup>2</sup>. Lewy body deposition has been shown to extend to the olfactory cortical areas as well<sup>3</sup>. Histopathological and functional studies of the OB are hence paramount to the understanding of the neurodegenerative process in PD.

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The availability of OB/OT samples from brain specimens in brain banks assumes high importance in this context. The Queen Square Brain Bank for Neurological Disorders, UCL Institute of Neurology, UK (QSBB) holds a collection of brains donated specifically for research into human neurodegenerative diseases and uses a protocol approved by a London Multi-Centre Research Ethics Committee where tissue samples are stored under a full license issued by the Human Tissue Authority.

## METHODS

We collected data regarding the presence or absence of material from the olfactory bulb and tract in cases received by the QSBB between the years of 2006 and 2010 (both years inclusive) to estimate availability of OB/OT material at the brain bank. The Queen Square Brain Bank receives post-mortem brain specimens after initial processing by local autopsy services. One half of each brain is randomly assigned to be flash-frozen and the other half, formalin-fixed. Our data is drawn from the pool of formalin-fixed halves.

## RESULTS

A total of 438 cases were received at QSBB over 5 years, and final histopathological diagnoses were as follows: control brain (n=21; 4.8%), Lewy body pathology (n=121; 27.6%) Tauopathies (n=112; 25.6%), Alzheimer's disease (n=62; 14.2%), Multiple system atrophy (n=45; 10.3%), others (n=77; 18%). Of these, 320 (73%) cases had data on availability of OB/OT. The OB/OT was present in at least one of the sides of the brain specimens in 94 cases (29.4%). Table shows the

comparison between cases which did or did not have OB available for post-mortem examination.

## DISCUSSION

The Queen Square Brain Bank receives post-mortem brain specimens after initial processing by local autopsy services. It is known that the OB/OT can be difficult to harvest because it can get stuck to the skull-base<sup>4</sup>, and other brain banks also have reported unavailability of OBs<sup>5</sup>. But to our knowledge, ours is the first study to suggest that post-mortem delay could have an impact on the availability of the OB. It is possible that post-mortem decomposition renders the tissue more friable and therefore causes rupture of the olfactory tract when the brain is pulled out of the skull<sup>6</sup>.

We also found that brains from females had a higher availability of OB than males (p<0.035, see table). The difference is statistically significant even after adjusting for post-mortem delay (p=0.028). However, the pathophysiologic or anatomic basis of this is as yet unclear, as previous studies have not found any difference in OB anatomy with regard to gender. It is well known that females have better olfaction than males<sup>8</sup> and therefore the possibility of underlying physiologic factors influencing the tissue characteristics of male and female OB/OT cannot be ruled out<sup>7</sup>.

For other brain banks which centralise collection from registered donors and are therefore dependant on the speed and technical expertise of the local autopsy services, this information might be relevant. We welcome data regarding the same, from other brain banks, which may help improve protocols for autopsy services around the world to ensure proper retrieval of olfactory structures and thus aid in future neurological research.

1. Table: Availability of olfactory bulb and possible correlates.

Correlates	Olfactory bulb Absent (n=226)	Olfactory bulb Present (n=94)	Significance p-value
Age in years: mean (SD; range)	73.2 (10.1; 38-99)	74.6 (12.4; 24-99)	0.317*
Gender: Number of females (%)	82 (36.3%)	46 (48.9%)	$\chi^2$ p value = 0.035; P value adjusted for age (p=0.51) and post-mortem delay (p <0.001) by logistic regression = 0.028
Post-mortem delay in hours: mean (SD; range)	63.4 (SD=28; 4.5-123.5)	50.5 (SD=27.5; 3.0-141.8)	<0.001*

SD: standard deviation; \*Student's t test

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