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Potential organ donors with primary brain tumours: missed opportunities for donation and transplantation identified in Australian cohort study 2010–2015

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Key words
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Abstract

Background: Potential organ donors with primary brain tumours (PBT) frequently donate, however some may be declined due to uncertainty about tumour classification or transmission risk to transplant recipients. We sought to describe transmission risk and donation outcome of potential donors with PBT, including identifying missed opportunities for transplantation, and any PBT transmission events.

Methods: We undertook a population-based cohort study in NSW of all potential donors 2010–2015. PBT potential donors were characterized according to tumour grade and transmission risk, and whether they donated organs. Data linkage was used to determine agreement of risk assessment of potential donors to that in the Biovigilance Register, and to identify any PBT transmissions.

Results: Of 2957 potential donors, 76 (3%) had PBTs. There was agreement of risk assessment in 44 (58%) cases. PBT potential donors had fewer comorbidities (1.6 vs. 2.1, $P = 0.006$) than non-PBT potential donors. Forty-eight (63%) potential donors were declined for non-PBT reasons, 18 (24%) were declined because of perceived PBT transmission risk and 10 (13%) donated. All PBT donors had WHO-I or -II tumours, and none had a ventriculo-pertioneal shunt. No transmission events occurred.

Conclusion: Donors with WHO-I/II PBT appear to have minimal risk of tumour transmission in solid organ transplantation; it is reassuring that no PBT transmission occurred. There is evidence of risk aversion to referrals with WHO-III/IV tumours. There exists opportunity to improve potential donor risk assessment at the time of referral using integrated data sets, and to increase organ donation and transplantation rates through greater utilization of PBT referrals.

Introduction

For patients with end-stage organ failure, transplantation is the optimal therapy. The shortage of donor organs represents a global challenge, with ~20 people each day in the USA dying while awaiting transplantation.[1] Australia has successfully increased organ donation rates in recent years to 22.2 donors per million population per year (dmpy)[2] although still lags many other nations including the UK (23.1 dpmy) and Spain (46.9 dmpy).[3] The recent rise in donation rates has been facilitated by efforts to increase referrals of potential organ donors from intensive care and emergency departments, along with greater acceptance of potential donors who are older or have comorbidity (expanded eligibility criteria). This has led to a huge increase in potential donors considered, but a much smaller increase in actual donors. However, there may be additional opportunities to increase donation rates from existing potential

donors that currently do not proceed to donate because of uncertainty about donor-recipient disease transmission risk (biovigilance).

A donor history of malignancy often contraindicates solid organ transplantation due to the potential risk of tumour transmission to an immunosuppressed recipient. However, primary brain tumours (PBTs) may be an exception. The overall risk of PBT transmission in solid organ transplantation has been estimated as 1.5%.[4–5] Factors that may theoretically increase risk of tumour transmission include recent disturbances of the blood–brain barrier, such as the presence of a ventriculo-peritoneal (VP) shunt, craniotomy or radiotherapy, although evidence is inconclusive.[6–7] Classification and grading of PBT is additionally complex, based on histogenesis and molecular parameters.[8] Metastatic disease is an absolute contraindication to donation but is rare even among malignant PBT, although ~70% of PBTs are benign. While previous research has focused on actual donors with PBTs, the population of potential donors with PBTs who are excluded from donation due to perceived biovigilance concerns have not been studied.

In Australia, decisions regarding medical suitability for donation are made by hospital and transplantation clinicians prior to organ retrieval. In the case of PBT, complexity in tumour grading and limited available information at time of potential donor evaluation may lead to an inaccurate perception of tumour grade. Where precise tumour information is lacking, estimating potential transmission risk to recipients may be uncertain, leading to a tendency to decline the potential donor. Even when tumour grade is known, uncertainty about absolute risk of transmission may lead to a risk-averse decision to forego donation. The integration of health records from multiple sources (such as administrative data sets and registries including the Central Cancer Registry)[9] in real-time decision making may increase available accurate information for decision making, preventing potential donors with low-risk tumours from being excluded.

We sought to investigate and describe the agreement of the PBT biovigilance risk classification during the donor procurement process to other medical records and registers; characterize PBT referrals and their donation outcomes; identify any tumour transmission events from PBT donors to organ transplant recipients; and quantify and describe any potential missed opportunities for donation. We defined a missed opportunity as a referral that did not proceed to donation due to concern about PBT transmission risk, but that had a risk profile that was of comparable or lesser risk to those who donated in terms of PBT and any other comorbidities.

Methods

Organ referral and donation process

This population-based cohort study was based in New South Wales (NSW), Australia. Organ donor coordination in Australia is managed by the Organ and Tissue Authority, which devolves to state-based Organ and Tissue Donation Services (OTDS). Hospital specialists identify and refer potential donors to the OTDS, which logs these referrals. Donation specialist staff then approach potential donor's next of kin for consent to donation. Referral evaluation will not proceed further without family consent.

Medical and surgical suitability for donation is determined prior to organ retrieval by the donation specialists at the OTDS, supported by a small team of specialist transplantation clinicians. This assessment is informed by medical history available at the time of referral, gathered from next-of-kin and any available medical records. This history forms the basis of the log-record collected by the OTDS, which may be updated throughout the referral process as additional sources of information become available. Where potential donors are declined, reasons are recorded, including where the potential donor may pose a significant biovigilance risk to transplant recipients. If deemed suitable, donation proceeds, coordinated by the OTDS. In Australia, only potential organ donors with next of kin consent, deemed medically suitable, proceed to organ retrieval. Hence, non-utilization rates of retrieved organs are very low.[10]

Data sets and linkage

This study utilized the OTDS log-records created at time of referral of a potential organ donor, reflecting medical history information available at time of donation decisions, linked with the Biovigilance in Organ Donation and Transplantation Register (Biovigilance Register), reflecting medical history available in other data sources. The Biovigilance Register was established under the NSW Public Health Act 2010 by the Ministry of Health, and includes all potential organ donors (including those evaluated but who did not proceed to donate) and transplant recipients, linked together probabilistically using best-practice privacy-preserving protocols. The Biovigilance Register includes additional detailed data sets and registers unavailable to OTDS and clinicians at time of potential organ donor decision-making (Fig. 1).[11] After completion of data linkage, only de-identified data were made available to researchers for this study. Ethical approval was obtained from the University of Sydney (project number 2016/758), with oversight provided by the University of Sydney Human Research Ethics Committee.

Identification of study cohort

We included all potential organ donors between January 2010 and December 2015 and transplant recipients of deceased donors referred during this time residing in NSW. First, we identified potential donors reported to have a PBT in OTDS referral logs. The Biovigilance Register linked data sources were then used to (i) verify the presence of PBTs already known from OTDS logs, (ii) to identify any other potential donors previously diagnosed with PBT, where this was not known in the OTDS referral logs, and (iii) confirm the WHO grade and so risk of transmission of all PBTs. To identify potential donors with PBTs in the Biovigilance Register, we used diagnosis codes corresponding to benign and malignant tumours of the central nervous system: C70, C71, C72, C75, D32 and D33.

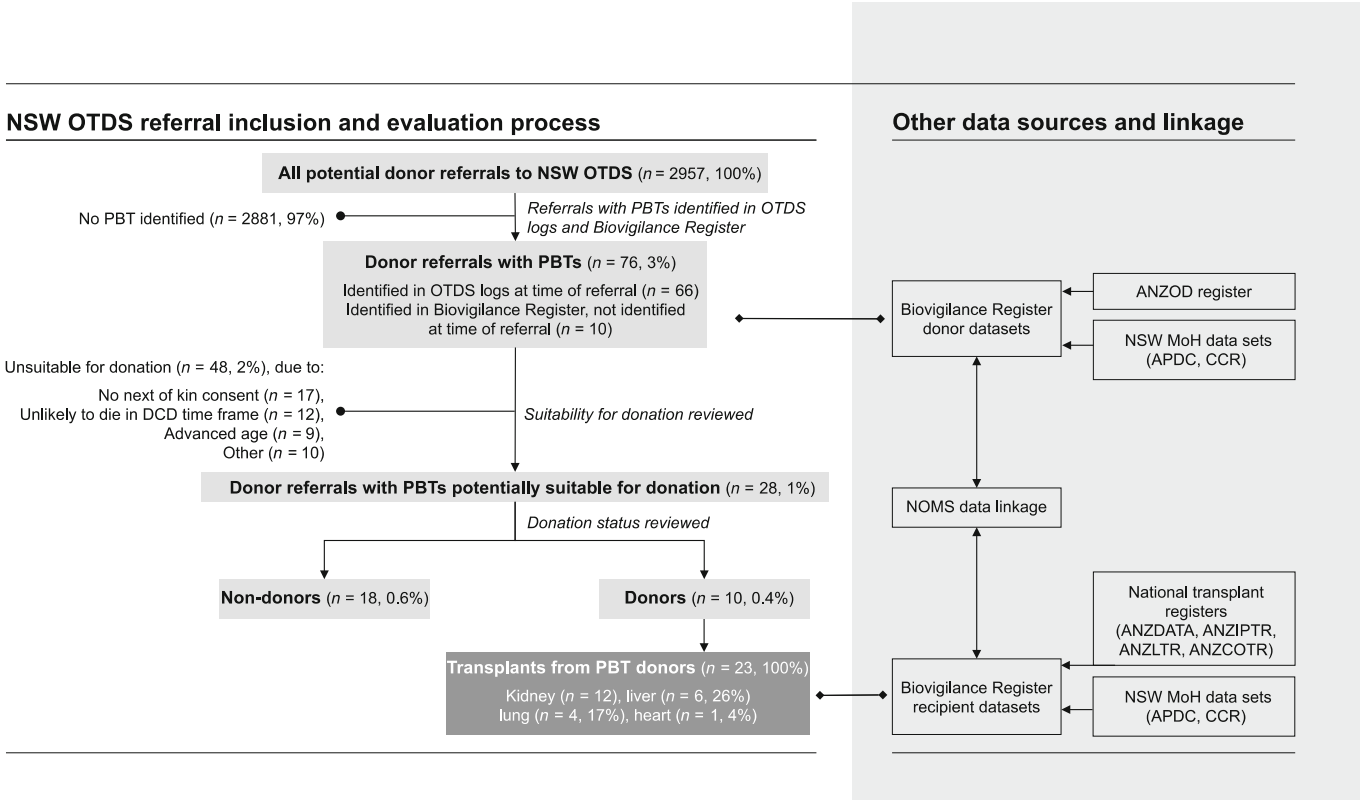

Fig. 1. PBT referral and evaluation process, 2010–2015. NSW OTDS, New South Wales Organ and Tissue Donation Service; PBT, primary brain tumour; NOMS, National Organ Matching Service; ANZDATA, Australian and New Zealand Dialysis and Transplant Registry, 1 January 1970–31 December 2016; ANZIPTR, Australian and New Zealand Islets and Pancreas Transplant Registry, 1 January 2000–31 December 2015; ANZLTR, Australian and New Zealand Liver Transplant Registry, 1 January 2000–31 December 2015; ANZCOTR, Australian and New Zealand Cardiothoracic Organ Transplant Registry, 1 January 2000–31 December 2015; ANZOD, Australian and New Zealand Organ Donor Register, 1 January 2000–31 December 2015; MoH, Ministry of Health; ADPC, NSW Admitted Patient Data Collection, 15 November 2000–30 September 2017; CCR, NSW Central Cancer Registry 1 April 1972–1 December 2013.

Characterization of PBT referrals and donors

We summarized potential donors with PBTs by characteristics recorded in OTDS referral logs, including date of referral, referring hospital location (regional or metropolitan), age, sex, cause of death, primary reason for non-donation if applicable and potential high-risk behaviours (intravenous drug use (IVDU), non-intravenous drug use (non-IVDU), incarceration, sex work, men who have sex with men, high-risk partner) and known comorbidities (hypertension, cardiovascular disease, respiratory disease, diabetes, hyperlipidaemia, chronic liver disease, chronic kidney disease and the presence of malignancy other than PBT). To estimate overall disease burden, any comorbidities were summed for each donor. We compared non-donors and donors, with and without PBT. T-tests were used to compare means, and Fisher's exact tests were used to compare proportions. Statistical analyses were conducted in Stata 15.

PBT classification and risk stratification

PBTs were classified using the World Health Organization (WHO) Classification of Tumours of the Central Nervous System, an internationally accepted standard.[8] The WHO grades tumours I–IV based on phenotypic, histologic and genotypic parameters. Higher-grade tumours demonstrate more abnormal features and are associated with a greater malignant potential and poorer prognosis.

Tumour transmission risk was assessed using the Transplantation Society of Australia and New Zealand (TSANZ) Guidelines for Organ Transplantation from Deceased Donors.[12] The TSANZ stratifies PBTs into three biovigilance risk categories: Not contraindicated (WHO-I and -II tumours, upper 95% CI (confidence interval) risk of transmission <1.5%), low-risk (WHO-III tumours, upper 95% CI risk of transmission between 1.5% and 6.4%), and intermediate-risk (WHO-IV tumours, upper 95% CI risk of transmission of ≥6.4%). This risk stratification and associated recommendations are consistent with that used in many other countries, including the UK and USA.[13–14]

We compared WHO grade and TSANZ risk classification of PBT as known at time of donor decision based on OTDS log-records, compared with details held by the Biovigilance Register. Agreement or disagreement between OTDS records and the Biovigilance Register were noted, for presence of PBT, and tumour classification. Where disagreement was present, PBT grade recorded in the Biovigilance Register superseded that in OTDS

referral logs, on account of the greater depth and breadth of medical records, data sets and registries included.

Transmission events and potential missed donor opportunities

We examined outcomes for recipients of organs from donors with PBT. For each recipient, follow-up began at the time of transplantation and continued until the recipient died or moved interstate from NSW (where their subsequent health records would not be accessible), or the study period data ended on 30th Sept 2017. Transmission of PBT was determined using the algorithm developed by the USA Organ Procurement Transplant Network (OPTN) and was based on donors' and recipients' cancer histories, as well as the number of recipients of the same donor.

Missed donation opportunities were defined as those potential donors who did not donate due to the presence of PBT but had a risk profile that was of comparable or lesser risk to those with PBT who donated. Potential missed opportunities were summarized by PBT characteristics and other comorbidities.

Results

Potential organ donors with PBTs

A total of 2957 potential donors were referred to the NSW OTDS between 2010 and 2015 (Fig. 1), of whom 76 (3%) had PBTs noted in OTDS referral logs or in the Biovigilance Register, or both. Among these 76, 48 (63%) did not proceed for reasons unrelated to PBT, including 17/76 with no next-of-kin consent, and 12/76 who were not brain dead and were subsequently deemed unlikely to die within the timeframe to become donation after circulatory death (DCD) donors. Of the remaining 28/76 cases, 10/28 proceeded to donation, while 18/28 did not due to perceived risk of PBT transmission (potential missed opportunities).

Characteristics of all potential donors, stratified by whether or not they had a PBT are presented in Table 1. PBT potential donors were younger (mean age 50.1 vs. 57.0 years, $P = 0.002$), more likely to be female (60% vs. 40%, $P < 0.001$) and with lower comorbidity burden (1.6 vs. 2.0, $P = 0.006$) than other potential donors (those without PBT). PBT potential donors also had a lower prevalence of many individual comorbidities, particularly less cardiovascular disease ($P < 0.001$) than other, non-PBT potential donors.

PBT classification and transmission risk

Among 76 potential donors with PBT, WHO-I tumours were the most common identified at time of referral (27/76, 36%), followed by WHO-IV tumours (24/76, 32%) (Table 2). Based on the TSANZ guideline risk classification, almost half (35/76, 46%) of PBTs were classified as not contraindicated for donation at time of referral (WHO-I and -II tumours with an upper 95% CI risk of transmission <1.5%), followed by intermediate risk (24/76, 32%, WHO-IV tumours with an upper 95% CI risk of transmission ≥6.4%), and low risk (4/76, WHO-III tumours with an upper 95% CI risk of transmission 1.5–6.3%). Three of 76 referrals (4%) had tumours of unspecified type, which had occurred in their distant medical history and were described as benign in OTDS logs, but without adequate information available to classify them according to WHO criteria or TSANZ transmission risk. Ten of 76 referrals (13%) were not known to have PBT by OTDS, but had records of these diagnoses noted in the Biovigilance Register. Glioblastoma multiforme (GBM) was the most common PBT identified at time of donor decisions (22/76, 29%), followed by meningioma (18/76, 24%) and astrocytoma (10/76, 13%). The majority (56/76, 74%) of referrals with PBTs had previously undergone surgery involving a craniotomy, and 10/76 (15%) PBT referrals previously or currently had a ventriculo-peritoneal (VP) shunt *in situ*.

In most cases (44/76 referrals, 58%), the tumour grade recorded in the OTDS referral log agreed with that recorded in Biovigilance Register linked health records (Table 2). In 5 of 76 potential donors, presence of PBT was identified in both OTDS referral logs and the Biovigilance Register, but type of PBT recorded differed, leading to a differential risk classification. In all of these cases OTDS log records resulted in overestimation of transmission risk. Seventeen of 76 (22%) potential donors were identified as having PBTs in OTDS referral logs, but without corresponding records in the Biovigilance Register. In 10/76 (13%) cases PBTs were identified in the Biovigilance Register but not on PTDS referral logs, so that PBT diagnosis had not been part of the donor decision-making process for these referrals.

Of the 76 PBT potential donors, 10 (13%) proceeded to donation. For these 10 cases, perceived tumour grade agreed with that in the Biovigilance Register in 5/10 cases. One of the 10 PBT donors had a tumour that was overestimated in grade, an astrocytoma that was perceived as WHO-III at time of donation decision but recorded in Biovigilance Register as WHO-II. In 2/10 cases the OTDS had not known about the prior PBT diagnosis, but the Biovigilance Register recorded a WHO-I meningioma and WHO-II glioma. There were also 2/10 PBT donors where OTDS recorded a WHO-I schwannoma and a WHO-II pituitary adenoma, but these diagnoses were not present in the Biovigilance Register records. Overall, WHO-I tumours were the most common (8/10), and no PBT donor truly had a WHO grade III or IV tumour (with the one astrocytoma perceived to be WHO-III subsequently being determined to be WHO-II). All donors had tumours risk-classified as not contraindicated or low risk by TSANZ guidelines. Meningiomas (3/10) and astrocytomas (3/10) were the most common tumour type. PBT donors had previously undergone surgery involving a craniotomy in 7/10 cases, but no PBT donor had a VP shunt previously or currently in situ.

PBT transmission events and potential missed opportunities for donation

Overall, donors with PBTs donated organs to 23 NSW resident transplant recipients (Table 3), with kidneys being most commonly donated (12/23, 52%). After a total of 860 months of follow up (median of 38 months per recipient, interquartile range 18–45 months), no transmission events occurred.

Table 1 Epidemiology of potential donors with and without primary brain tumours (PBT) and the subset of those who proceeded to donate, in NSW 2010–2015

Characteristic *N* (%)	All potential donor referrals			Actual organ donors		
	Non-PBT	PBT	*P*	Non-PBT	PBT	*P*
Total (%)	2881 (100)	76 (3)		549 (19)	10 (0)	
Year			0.01			0.8
2010	367 (13)	3 (4)		82 (15)	1 (10)	
2011	365 (13)	12 (16)		74 (13)	0 (0)	
2012	445 (15)	9 (12)		84 (15)	1 (10)	
2013	464 (16)	23 (30)		96 (17)	3 (30)	
2014	533 (19)	14 (18)		91 (17)	2 (20)	
2015	707 (25)	15 (20)		122 (22)	3 (30)	
Demographics						
Age, mean (SD)	57.0 (18.9)	50.1 (21.0)	0.002	49.8 (18.2)	44.4 (17.7)	0.4
Sex			0.001			0.4
Female	1158 (40)	45 (59)		245 (45)	6 (60)	
Male	1713 (60)	31 (41)		304 (55)	4 (40)	
Residence			0.5			0.2
Regional	553 (23)	15 (22)		113 (25)	4 (44)	
Major city	1821 (77)	52 (78)		348 (75)	5 (56)	
Not reported	507	9		88	1	
Comorbidities						
Number, mean (SD)	2.0 (1.5)	1.5 (1.6)	0.006	1.6 (1.4)	0.9 (0.7)	0.01
Cardiovascular disease	1888 (66)	32 (42)	<0.001	322 (59)	3 (30)	0.1
Respiratory disease	391 (14)	7 (9)	0.4	69 (13)	1 (10)	0.9
Diabetes	465 (16)	9 (12)	0.4	18 (3)	0 (0)	0.6
Hypertension	949 (33)	19 (25)	0.2	167 (30)	3 (30)	0.9
Hyperlipidaemia	421 (15)	7 (9)	0.2	111 (20)	2 (20)	0.9
Cancer (excl. PBT)	376 (13)	9 (12)	0.9	42 (8)	0 (0)	0.9
Liver disease	137 (5)	2 (3)	0.6	10 (2)	0 (0)	0.9
Kidney disease	213 (7)	5 (7)	0.9	12 (2)	0 (0)	0.9
High risk behaviours						
Number, mean (SD)	0.2 (0.5)	<0.1 (0.2)	0.02	0.2 (0.6)	0	0.2

P-values were calculated using *t*-test (to compare means), and Fisher's exact test (to compare proportions). % are column proportions unless indicated. High risk behaviours included intravenous drug use (IVDU) and other illicit drug use, recent incarceration, sex work, high-risk partners and men who have sex with men.

There were 18 potential donors who did not donate identified as possible missed opportunities for donation. Of these, the majority (10/18, 56%) had WHO-IV, TSANZ intermediate risk tumours (2.2% risk of transmission with an upper 95% CI of ≥6.4%), which were all glioblastoma multiforme. One of these 18 potential donors had a WHO-I meningioma, 1/18 a WHO-II ependymoma, and 1/18 a WHO-III astrocytoma. In all of these 13/18 (72%) cases, there was agreement of risk classification between OTDS referral logs and the Biovigilance Register, so donation decisions had been made with correct information for assessing potential transmission risk. Of the remaining 5/18 potential donors with PBT, disagreement in risk occurred in two cases, both due to OTDS records perceiving WHO-IV glioblastoma multiforme at time of donation decisions, but that were recorded in the Biovigilance Register as WHO-III astrocytomas. Another two potential donors were noted to have PBT in OTDS referral logs, however, inadequate information was provided to classify them according to WHO criteria and no PBT could be identified in the Biovigilance Register. One potential donor was noted to have a history of WHO-I meningioma that could not be identified in the Biovigilance Register.

Table 2 Primary brain tumour (PBT) tumour grade as recorded in organ and tissue donation service (OTDS) potential donor logs (perceived) cross-tabulated with records in the biovigilance register linked health data sets (verified)

Perceived grade (at donor decision)	Verified grade (health records via Biovigilance Register)					
	WHO-I	WHO-II	WHO-III	WHO-IV	Unverifiable	Total
No tumour	5	3	0	2	-	10
WHO-I	21	0	0	0	6	27
WHO-II	0	4	0	0	4	8
WHO-III	1	1	1	0	1	4
WHO-IV	0	0	3	18	3	24
Unspecified	0	0	0	0	3	3
Total	27	8	4	20	17	76

Perceived: PBT tumour grade as recorded in organ donor referral logs, based on information known at time of referral. Verified: PBT tumour grade based on corroborating information from Biovigilance Register linked data sets.

Table 3 Tumour characteristics of potential donors with primary brain tumours who proceeded to donate

Tumour type	Total	WHO grade[8]	Craniotomy	Organ recipients					Follow-up (months)		Recipient transmission
				Total	Kidney	Liver	Lung	Heart	Total	Median	
Total	10	-	7	23	12	6	4	1	841	38	0
Meningioma	3	I	3	7	4	2	1	0	386	49	0
Schwannoma	2	I	1	3	1	1	1	0	49	24	0
Astrocytoma (giant cell)	1	I	0	1	0	1	0	0	22	22	0
Astrocytoma (unspecified)	2	I	2	7	4	1	1	1	217	38	0
Pituitary adenoma (unspecified)	1	II	1	4	2	1	1	0	156	39	0
Glioma (benign)	1	II	0	1	1	0	0	0	31	31	0

Follow-up includes time in NSW only. No pancreata were donated.

Discussion

The novelty of our work is the ability to analyse a large cohort of potential donors, including those who did not proceed to donation. Our results demonstrated that potential donors with PBT are typically younger and have fewer comorbidities than other potential donors. Increasingly, organ donors are older and bear a greater burden of multi-morbidity.[15] While expanded criteria donors frequently donate successfully, recipients of their organs may have suboptimal graft function and survival.[16] In this context, and that of the growing need for transplanted organs more broadly, efforts to safely maximize the utility of younger donors without chronic diseases, including those with PBTs, are important.

Accurate biovigilance risk classification at time of potential donor evaluation is essential if donation possibilities are to be fully realized. In a significant minority of cases, we found perceived PBT grade at time of donation decisions disagreed with that in the Biovigilance Register, including several cases of overestimated grade and risk. This may reflect the complexity of the grading system, whereby one tumour type may span multiple WHO grades differentiated by histopathological characteristics, which may not be readily accessible by donation services, or when accessible, expertise for interpretation may be difficult to obtain. This highlights the value of real-time availability of health data sets to provide a more comprehensive medical history in the time-sensitive setting of assessment for organ donation, and the need for better decision support. Our results also add to the body of evidence that indicates that transmission of PBT from donors to transplant recipients is rare. Of note, there were donors who donated without harm, who had a history of PBT unrecognized by OTDS, and also donors foregone on the basis of perceived PBT that had no corresponding records in any health data sets for these potential donors.

Among donors foregone, those with WHO-I/II PBTs are of comparable risk to many who became donors and likely represent missed opportunities for donation. Potential donors with WHO-III/IV PBTs may also represent missed opportunities, although transmission risk could not be demonstrated in our study and evidence of risk is less certain. In keeping with the findings of other studies, in our study no PBTs were transmitted to transplant recipients.[13] While there are published cases of tumour transmission,[18–21] the risk in PBT (1.5–2.2%) is comparable to that of other low-risk malignancies, including prostate cancer with Gleason score < 6 and minimally invasive thyroid follicular carcinoma 1–2 cm in size.

The risk for GBM transmission via solid organ transplantation has previously been calculated at 2.2%, with an upper 95% CI of ≥6.4%.[4] There are case reports of GBM transmission through solid organ donation, particularly in the context of other factors that increase tumour transmission risk, such as the presence of a biopsied lymph node positive for malignant cells.[22] However, a review of other studies including transplants from at least 48 donors with GBMs did not demonstrate recipient transmission.[5] Guidelines on the use of donors with PBTs have varying recommendations on donation from donors with GBM, but emphasize cautiously balancing the risks of tumour transmission against the risk of remaining on the transplant waiting list.[9,13,23] Further evidence will only arise if these potential organ donors are utilized when appropriate.

Although there are risks associated with organ transplantation from donors with PBTs, there are also other important risks that are considered in the organ transplantation process. During this study over 200 potential recipients died while awaiting organ transplantation in Australia, and many more were delisted for temporary or permanent health issues.[24] The survival benefit of transplantation for patients with end-stage organ failure is well documented. In the case of recipients of solid organs from donors with PBTs, it has been estimated that receiving an organ may confer an additional 8 years of life over waiting for transplantation.[4] In another study of 1220 recipients of organs from donors with PBTs, Kauffman *et al.* found no statistical difference in survival between recipients of solid organs from donors with PBTs, and recipients of organs from donors without.[25] As a result, while there is risk associated with WHO-IV PBTs, in particular with GBM, this must be balanced against the risks associated with not receiving a transplant.

Our study has several notable strengths. The Biovigilance Register is a comprehensive data set that encompasses best available data on all organ donor referrals and transplant recipients in NSW. NSW is Australia's most populous state, representing a third of the nation's population, and accounting for a large proportion of organ transplants performed every year. This study is unique in that it considers a pool of potential organ donor referrals who are considered for organ donation but do not proceed to donate, as well as actual organ donors and their transplant recipients. The findings of

this study are pertinent and readily generalizable to other Australian states, and countries with comparable demographics and organ donation systems.

As Australia has a national organ donation system where donors frequently donate to recipients who reside interstate, there are likely to be additional recipients of organs from these donors with PBTs who could not be followed up in this study, as we could not access and link health records outside of NSW. It is also possible that transmission events may occur after the period of follow-up for this study, however as the Biovigilance Register will continue to be updated these will be identified in the future if they occur. Case reports of PBT transmissions in transplantation also indicate that when PBT transmission does occur, it typically does so within 18–24 months of transplantation,[16–19,26] less than our median follow-up of 38 months.

Conclusions and implications

Our study indicates that it is likely donation opportunities from potential donors with PBT are not fully realized, that under current practice donor transmission of PBT to recipients does not occur, and that donor decisions may be risk averse. Further research into transmission risk associated with GBM is warranted. This study also has implications for broader organ procurement health service provision. Real-time availability of administrative health data may improve accuracy of risk stratification when donor decisions are made. This could be utilized to improve evidence-based decision support for clinicians regarding acceptable levels of risk in organ transplantation.

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Author contributions

Imogen K. Thomson: Data curation; formal analysis; writing – original draft. **James Hedley:** Data curation; formal analysis; writing – review and editing. **Brenda M. Rosales:** Data curation; writing – review and editing. **Kate Wyburn:** Supervision; writing – review and editing. **Michael J. O'Leary:** Project administration; writing – review and editing. **Angela C. Webster:** Conceptualization; methodology; project administration; writing – review and editing.

Conflict of interest

None declared.

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