Advance Directives and End-of-Life Care: Knowledge and Preferences Among Brain Cancer Patients in Anhui, China

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Abstract

**Background:** Advance directives and end-of-life care has not been well acknowledged among tumor patients in China Mainland, especially in brain tumor patients who may have unconsciousness at the early stage of illness. Thus, this study aims to clarify the knowledge and preferences of advance directives and end-of-life care of brain tumor patients and to investigate the predictors of patients’ preferences.

**Methods:** This was a population-based cross-sectional survey conducted by a face-to-face interviews. Information on sociodemographic factors, brain tumor diseases, knowledge and preferences of advance decisions, end-of-life care were collected.

**Results:** 88.61% participants had never heard of AD but 65.18% would like to make an AD. Knowledge of AD, receiving the treatment of surgery or radiotherapy, less than 70 years old, male, educational qualification of college or more, without children, medical insurance for non-working or working urban residents, pay their medical expenses by themselves as predictors of preferring to make an AD. 79.43% participants would like to discuss end-of-life arrangements with medical staff and 63.29% were willing to receive end-of-life care though it cannot delay death. 65.82% brain tumor patients wanted resuscitation, as high as 45.45% thought they didn’t need life support if they were in a persistent vegetative state. Brain primary tumor, less than 70 years old, male, educational qualification of junior middle school or less, have children, new rural cooperative medical insurance, pay their medical expenses by their children or spouse as predictors of choosing end of life care though it cannot delay death.

**Conclusions:** Advance directives and end-of-life care has not been well acknowledged among brain tumor patients in China Mainland. More efforts should be encouraged in the patients with primary brain tumors, who undergoing surgery and radiotherapy and low socioeconomic status, and an appropriate decision-making timing with a technology-based communication is encouraged in promoting advance directives in Chinese brain tumor patients.

**Key Points**

Advance directives and end-of-life care has not been systematically applied to Chinese brain cancer patients and the knowledge of advance directives is limited.

More efforts should be made for the participants with primary brain tumors, who undergoing surgery and radiotherapy and low socioeconomic status.

An appropriate decision-making timing with a technology-based communication is encouraged in promoting advance directives in Chinese brain tumor patients.

1 Introduction

“Advance directives” is a legal form for people to document their end-of-life care decisions that honor their individual values and preferences.1–2 Advance directives discussions are rather challenging and
complicated in Chinese Mainland and there are still no relevant legal document, the impact for patients with cancer is inevitable and important cause it is reported that cancer patients who convey their individual values and end-of-life decisions are more likely received care that they aspiration.³ Advance directives will help patients to understand end-of-life decisions-making more fully, which can generate an appropriate therapeutic schedule that may include less chemotherapy and targeted medicine, fewer hospitalizations.⁴ Moreover, advance directives conduce cancer patients spend meaningful time with families and die with dignity, it is imperative that oncology medical staff perform investigation of advance directives discussions among cancer patients. Especially in brain tumor patients comparing with other kinds of cancer (eg, lung cancer) who would be consistently awake, patients may have unconsciousness at the early stage of illness, so it is particularly important to implement advance directives in brain tumor patients. However few studies concentrate on the knowledge and preferences of advance directives among Chinese cancer patients, especially brain tumor patients. In this article, we will explore the challenges remains in the knowledge and preferences of advance directives and end-of-life care decisions among brain tumor patients and investigate the role that the brain tumor illness, sociological status and economy condition play in predicting the preferences of participants.

2 Methods

2.1 Participants and Study design

Brain tumor patients who aged over 18 years old without disturbance of consciousness were recruited from Cancer hospital, Chinese academy of science, Hefei and The First Affiliated Hospital of Anhui Medical University. All participants were approved by their families and know their own real illness condition. This cross-sectional study was conducted from January 1 to February 20, 2020, all brain tumor patients who met the inclusion criteria were interviewed, of which 44 were unwilling to be interviewed. Ethical approval of the research protocol (SL-KY2020-002) was granted by Cancer hospital, Chinese academy of science, Hefei Ethics Committee.

2.2 Data collection

All data were collected by our research team through a face-to-face interviews. Considering that not all brain tumor patients recognize words, so we read the question and answer on the questionnaire and recorded the answer of patients’. The questionnaire was formulated according to literatures about advance directives and end of life care. Questionnaire on advance directives was mainly constituted of two parts: the first part questions were about (1) Do you heard of advance directives; (2) The willingness of making an advance directives, the second part are reasons why brain tumor patients making or not making an advance directives. Questionnaire on end of life care has four questions (Q1: The willingness of discussing illness and end-of-life arrangements directly; Q2: The preference of receiving end of life care; Q3: The willingness of receiving resuscitation; Q4: The requirement of life support). All categorizations of the measurements are listed in Table 3 and Table 4. Information about
sociodemographic factors, type of brain tumor, history of brain tumor, patient general condition were also obtained.

| Questions                                                                 | Answers | n%    |
|---------------------------------------------------------------------------|---------|-------|
| Do you heard of advance directives?                                       | Yes     | 36(11.39%) |
|                                                                           | No      | 280(88.61%) |
| If advance directives are legal in China and you are in a condition which you cannot make your own medical decisions (e.g. coma), would you like to make advance directives? | Yes     | 206(65.18%) |
|                                                                           | No      | 110(34.82%) |
| Reasons for using advance directives:                                    |         |       |
| Make sure the end of life is comfortable and avoid painful feeling        | 93(45.15%) |
| Avoid burdening family economic condition                                 | 66(32.03%) |
| Hope own wishes could be respected                                       | 23(11.17%) |
| Avoid imposing burdens on society                                         | 3(1.45%) |
| Consider the quality of life is more important than the length of life    | 19(9.23%) |
| Religious beliefs                                                         | 0       |
| Witness the rescue of other people                                       | 2(0.97%) |
| Reasons for not using advance directives:                                 |         |       |
| Family members will decide for me                                         | 15(13.64%) |
| Let it be                                                                 | 5(4.55%) |
| No need to think about it now and doctor will decide for me               | 34(30.91%) |
| My decision may change                                                    | 6(5.45%) |
| Not familiar with the concept of advance directives                       | 47(42.73%) |
| Religious beliefs                                                         | 3(2.72%) |

Table 3
Knowledge and Preferences of Advance Directives Among the Study Participants (n=316)
| Independent Predictors | OR   | 95%CI    | P Value |
|------------------------|------|----------|---------|
| **Heard of AD**        |      |          |         |
| Yes                    | 4.727| 1.626-13.745 | 0.04*   |
| No (reference group)   | 1    |          |         |
| **Treatment currently receiving** |      |          |         |
| Surgery                | 34.5 | 4.918-242.028 | 0.001*  |
| Radiotherapy           | 14.223 | 2.985-67.778 | 0.001*  |
| Medicine               | 1.25 | 0.232-6.739 | 0.795   |
| Support treatment (reference group) | 1 |          |         |
| **KPS scores**         |      |          |         |
| 50                     | 2.426 | 0.951-6.190 | 0.064   |
| 60-79                  | 0.954 | 0.560-1.626 | 0.862   |
| 80 (reference group)   | 1    |          |         |
| **Age, years**         |      |          |         |
| 30-49                  | 4.756 | 1.971-11.476 | 0.001*  |
| 50-69                  | 3.424 | 2.031-5.773 | 0.001*  |
| 70-89 (reference group) | 1   |          |         |
| **Sex**                |      |          |         |
| Male                   | 3.224 | 1.861-5.586 | 0.001*  |
| Female (reference group) | 1 |          |         |
| **Educational Qualifications** |      |          |         |
| Junior middle school or less (reference group) | 1 |          |         |
| Senior high school     | 0.848 | 0.428-1.503 | 0.572   |
| College or more        | 3.905 | 1.131-13.487 | 0.031*  |
| **Residence**          |      |          |         |
| Rural                  | 0.281 | 0.375-1.330 | 0.281   |
| City (reference group) | 1    |          |         |
| **Children**           |      |          |         |
| None                   | 3.789 | 1.789-8.028 | 0.001*  |
| Have (reference group) | 1 |
|------------------------|---|
| **Type of medical insurance** | |
| New rural cooperative medical insurance (reference group) | 1 |
| Medical insurance for non-working urban residents | 2.767 | 1.171-6.535 | 0.02* |
| Medical insurance for working urban residents | 11.62 | 1.528-88.389 | 0.018* |
| **Who will cover your medical expenses?** | |
| Own | 2.568 | 1.511-4.365 | ≤0.001* |
| Children or spouse (reference group) | 1 |

AD, advance directives; OR, odds ratio; CI, confidence interval. *p<0.05

Table 4
Binary Logistic Regression Model Predicting AD (n=316)

2.3 Data analysis

The data were analyzed by SPSS 22.0 (IBM Corp, Armonk, NY). Relationship between brain tumor participants' sociodemographic factors, history of brain tumor and preference of choosing AD, attitudes of receiving end-of-life care were analyzed by binary logistic regression. All P value less than 0.05 were considered to be statistically significant.

3 Results

3.1 Characteristics of Study Participants

As shown in Table 1, The sociodemographic characteristics of the 316 brain tumor participants who aged over sixty are reported which including 65.19% female patients and 60.12% brain tumor patient respectively. For marital status: around two-thirds participants had married, 15.83% divorced, 11.39% unmarried, 8.86% lost their spouse. Over 70% participants have a junior high school education or below, only 24 had a bachelor/postgraduate/PhD degree. Although only 17.21% participants were urban resident, 76.9% participants had their own private housing. What's more, the type of medical insurance of participants were related to their residence, 82.28% were new rural cooperative medical insurance, 22.71% were medical insurance for non-working urban residents, only 6.01% were medical insurance for working urban residents.
| Social and Demographic Characteristics | n(%) |
|---------------------------------------|------|
| **Age, years**                        |      |
| 30-39                                 | 18(5.69%) |
| 40-49                                 | 20(6.32%) |
| 50-59                                 | 88(27.84%) |
| 60-69                                 | 97(30.69%) |
| 70-79                                 | 72(22.78%) |
| 80-89                                 | 21(6.64%) |
| **Sex**                               |      |
| Male                                  | 110(34.81%) |
| Female                                | 206(65.19%) |
| **Marital status**                    |      |
| Married                               | 202(63.92%) |
| Divorced                              | 50(15.83%) |
| Unmarried                             | 36(11.39%) |
| Widowed                               | 28(8.86%) |
| **Educational Qualifications**        |      |
| Junor middle school or less           | 229(72.47%) |
| Senior high school                    | 63(19.94%) |
| College or more                       | 24(7.59%) |
| **Residence**                         |      |
| Rural                                 | 260(82.29%) |
| City                                  | 56(17.21%) |
| **Type of housing**                   |      |
| Private housing                       | 243(76.9%) |
| Retal housing                         | 22(6.96%) |
| Children's housing                    | 51(16.14%) |
| **Religious belief**                  |      |
| None                                  | 234(74.05%) |
| Have | 82(25.95%) |
|------|------------|
| **Children** |  |
| None | 61(19.3%) |
| Have | 255(80.7%) |
| **Type of medical insurance** |  |
| New rural cooperative medical insurance | 260(82.28%) |
| Medical insurance for non-working urban residents | 37(11.71%) |
| Medical insurance for working urban residents | 19(6.01%) |
| **Who will cover your medical expenses?** |  |
| Own | 110(34.81%) |
| Children or spouse | 206(65.19%) |

Table 1
Characteristics of Brain Cancer Patients (n=316)
The tumor-related characteristics of the 316 participants are reported in Table 2. Over two-third participants were brain metastases, of which the site of primary tumor, lung cancer were 32.27%, breast were 35.75%. In primary brain tumor, nearly quarter were glioma, only three patients were meningioma and one patients was brain lymphoma. When participants did our interview, 73.74% participants were receiving radiotherapy, 8.22% were receiving surgery and 14.55% were receiving medicine, only 11 participants were undergoing support treatment. Slightly more than one-half participants were were ill less than 12 months, but there were still 18.68% participants lived over 25 months. Only 26.27% brain tumor patients in good general condition which KPS score was over 80, over 70% brain tumor patients had a poor KPS score which was less than 80 and even less than 50.
| Morbid Characteristics          | n(%)       |
|--------------------------------|------------|
| **Type of brain tumor**        |            |
| Glioma                         | 78(24.68%) |
| Meningioma                     | 3(9.49%)   |
| Lymphoma                       | 5(1.58%)   |
| Brain Metastases               |            |
| From lung cancer               | 102(32.27%)|
| From breast cancer             | 113(35.75%)|
| From other cancer              | 15(4.73%)  |
| **Treatment currently receiving** |         |
| Surgery                        | 26(8.22%)  |
| Radiotherapy                   | 233(73.74%)|
| Medicine                       | 46(14.55%) |
| Support treatment              | 11(3.49%)  |
| **Duration of illness**        |            |
| 1 month or less                | 81(25.63%) |
| 2 months to 6 months           | 32(10.13%) |
| 7 months to 12 months          | 54(17.08%) |
| 12 months to 24 months         | 90(28.48%) |
| 25 months or more              | 59(18.68%) |
| **Symptoms**                   |            |
| Headache                       | 181(57.27%)|
| epilepsy                       | 21(6.65%)  |
| Movement disorders             | 78(24.69%) |
| Language disorders             | 36(11.39%) |
| **KPS scores**                 |            |
| 50                             | 37(11.71%) |
| 60-79                          | 196(62.02%)|
| 80                             | 83(26.27%) |
3.2 Advance Directives

Knowledge, attitudes and preferences of advance directives were summarized in Table 3. A very low proportion of brain tumor patients had ever heard of AD, 88.61% had never heard of AD. But after introducing the concept of advance directives to them, almost two-thirds participants would like to make an AD. As shown in Table 3, the main reason for those willing to make an AD were to ensure more comfortable at the end of life and reduce the financial burden on the family. For those who would not like to make an AD, the key reason was not familiar with the concept of advance directives or they thought doctors (30.91%) or family member would decide for them.

3.3 Predictors of AD

Bivariate analyses identified knowledge of AD, receiving the treatment of surgery or radiotherapy, less than 70 years old, male, educational qualification of college or more, without children, medical insurance for non-working or working urban residents, pay their medical expenses by themselves as significant predictors of preferring to make an AD. Table 4 shows the results of binary logistic regression model.

3.4 End of Life Care

Table 5 shows attitudes and preferences toward end of life care. 79.43% participants would like the medical staff to discuss end-of-life arrangements with them. 63.29% were willing to receive end-of-life care though it cannot delay death. Over one-half brain tumor patients wanted resuscitation, while 27.21% didn’t, besides 6.97% participants were not sure. If patients were in a persistent vegetative state, as high as 45.45% thought they didn’t need life support, whereas 50.63% agreed with life support, furthermore 7.92% participants couldn’t make up their mind.
| Questions                                                                 | Answers | n%     |
|--------------------------------------------------------------------------|---------|--------|
| Would you like the medical staff to discuss your illness and end-of-life arrangements directly with you? | Yes     | 251    |
|                                                                          |         | 79.43% |
|                                                                          | No      | 65     |
|                                                                          |         | 20.57% |
| If you are at the end of life, are you willing to receive end-of-life care? Although it cannot delay death. | Yes     | 200    |
|                                                                          |         | 63.29% |
|                                                                          | No      | 116    |
|                                                                          |         | 36.71% |
| At the end of your life, do you want your doctor to resuscitate you through resuscitation (cardiopulmonary resuscitation, electrical defibrillation, endotracheal intubation, tracheotomy)? | Yes     | 208    |
|                                                                          |         | 65.82% |
|                                                                          | No      | 86     |
|                                                                          |         | 27.21% |
|                                                                          | Not sure| 22     |
|                                                                          |         | 6.97%  |
| Do you need life support (including nutritional support such as tube feeding or percutaneous endoscopic gastrojejunostomy, broad-spectrum antibiotics, blood transfusions, ventilator assisted ventilation) if you are in a persistent vegetative state (such as brain tumor progression)? | Yes     | 131    |
|                                                                          |         | 41.45% |
|                                                                          | No      | 160    |
|                                                                          |         | 50.63% |
|                                                                          | Not sure| 25     |
|                                                                          |         | 7.92%  |

Table 5
Knowledge and Preferences of End-of-Life care Among the Study Participants (n=316)

3.5 Predictors of EOL Care

Bivariate analyses identified brain primary tumor, less than 70 years old, male, educational qualification of junior middle school or less, have children, new rural cooperative medical insurance, pay their medical expenses by their children or spouse as significant predictors of choosing end of life care. Table 6 shows the results of binary logistic regression model.
| Independent Predictors | OR   | 95%CI          | P Value |
|------------------------|------|----------------|---------|
| **Type of brain tumor** |      |                |         |
| Brain Primary Tumor    | 4.242| 2.220-8.108    | 0.000*  |
| Brain Metastases(ref. group) | 1   |                |         |
| **Age, years**         |      |                |         |
| 30-49                  | 0.119| 0.051-0.277    | 0.000*  |
| 50-69                  | 0.412| 0.230-0.740    | 0.003*  |
| 70-89(ref. group)      | 1    |                |         |
| **Sex**                |      |                |         |
| Male                   | 1.911| 1.156-3.160    | 0.012*  |
| Female(ref. group)     | 1    |                |         |
| **Educational Qualifications** | |             |         |
| Junor middle school or less(ref. group) | 1 | | |
| Senior high school     | 0.376| 0.213-0.665    | 0.001*  |
| College or more        | 0.207| 0.084-0.506    | 0.001*  |
| **Residence**          |      |                |         |
| Rural                  | 1.054| 0.577-1.923    | 0.865   |
| City(ref. group)       | 1    |                |         |
| **Children**           |      |                |         |
| None(ref. group)       | 1    |                |         |
| Have                   | 1.955| 1.056-3.611    | 0.033*  |
| **Type of medical insurance** | |             |         |
| New rural cooperative medical insurance | 6.435| 2.065-20.050  | 0.001*  |
| Medical insurance for non-working urban residents | 3.187| 0.888-11.447 | 0.076 |
| Medical insurance for working urban residents (ref. group) | 1 | | |
| **Who will cover your medical expenses?** | |             |         |
| Own(ref. group)        | 1    |                |         |
| Children or spouse    | 4.131| 2.531-6.744    | 0.000*  |

OR, odds ratio; CI, confidence interval. *p ≤ 0.05
4 Discussion

4.1 Advance directives

Compared to other research, which record 23.6% of cancer patients who receive radiotherapy had already signed an AD, in this study only 11.39% participants had heard of it. Considering this study was carried in Germany which is a developed country and participants had a good education and advanced medical care, whereas our brain tumor patients were from Anhui Province of China whose economy is relatively backward, so the knowledge of AD is rather low. But after introducing the concept of advance directive, 65.18% preferred to make an AD, which is not consistent with previous study which 22.4% cancer patients approved the AD. This may be due to participants were in different part of China that the culture were different to some extent, and previous study contained all kinds of cancer patients, however our study contained brain tumor patients only and from one Anhui region. Among brain tumor patients who approved AD, avoiding painful feeling and burdening family economic condition were two main reasons, whereas not familiar with advance directives and thought doctor would decide for them were two main reasons for brain tumor patients who didn't approve AD. We found that it is important for patients with brain tumors to understand the concept of advance directives and this can promote the promotion of advance directives among brain tumors patients in mainland China meanwhile it can encourage the formation of subsequent related policies and regulations relating to advance directives. For brain tumor patients, advance directives can prevent inappropriate treatment when they unconscious.

4.2 Predictors of advance directives

The strongest predictors of AD were receiving surgery and radiotherapy, which is not consistent with previous study that knowledge of AD was the primary predictor. For these brain tumor patients, surgery treatment is usually for the early stages of the disease which is mean patients are in a good condition and they often have a positive perspective of their disease and they also cannot fully understand their own illness, so the timing for our interviews about advance directives has a significant impact on the choice of AD. Brain tumor patients who receiving surgery or radiotherapy in our study would like to make an AD may because they were lack of good illness understanding and realistic expectations about prognosis. As a study suggested when advance directives were made early, those cancer patients cannot be able to predict consistently what they want at the end of life because they may doubt with the reality of their cancer diagnosis. And patients who can totally understood that the role of radiotherapy and medicine only can stabilize disease or prolong their life were more likely to utilize less aggressive treatment. So finding an optimal time for tumor patients to make an AD is a challenge for us and to some extent, interviews of AD cannot be performed at a single time. Instead, in the future a longitudinal study should be encouraged to ensure the authenticity and consistency of advance directives.
Next, we found the educational qualification of college or more, medical insurance for non-working or working urban residents, pay their medical expenses by themselves are predictors of AD. These independent predictors were related with education and costs, like other study which found if the treatment is free, the rate which Chinese patients with cancer would like to choose artificial ventilation will increase almost 20%. Another study also reported that a higher proportion of Chinese members with higher education had heard of AD and wanted to make an AD. In our study, brain tumor patients who had the medical insurance for non-working or working urban residents usually lived in modern city and had jobs, which mean they had the major source of income, and the type of their medical insurance can cope with the medical costs of treatment for 95%, so these participants wanted to make an AD because well education and economic independence made them had their own decision-making power. Among patients with brain tumors, the poorer economic groups and the less educated groups should strengthen the advancement of advance directives to ensure the popularity of advance directives among various economic income groups. We also confirm with the economic development in Anhui, the overall economic situation of the groups will be improved so this way the application of advance development would be better guaranteed.

We also found participants who were younger, male and without children were willing to make an AD. In our study, older participants were less likely to make an AD, this is consistent with a study in Switzerland which identifying preferences and values expressed in ADs of 50 elderly patients with cancer, and they found only a minority of elderly cancer patients were prepared to put their personal wishes in writing. This may due to older participants were more sensitive to our Chinese traditional culture Confucianism, however younger people were less influenced by it and were more likely to express their individual value. Women in our Chinese culture were more likely to resign themselves to their husband, so male was one predictor of making an AD. Participants without children want to make an AD may due to there didn't have such an immediate relative to discuss their disease condition. Although women and the elderly are reluctant to give advance directives because of Chinese Confucian culture, advance directives still need to be popularized among women and the elderly so that everyone’s dignity can be reflected.

4.3 End of life care

In our study, 79.43% participants would like to discuss their illness and end-of-life arrangements directly with medical staff, and 63.29% participants were willing to receive EOL care though it can only delay death for a few days. While a survey of 1067 adults about preferences of end-of-life care in HONG KONG reported that 92.2% participants thought it was a good practice for medical staff to talk to patient directly about their situation and end-of-life arrangements, and 87.6% participants would prefer to receive appropriate palliative care which may not prolong their life. This may due to the participants in our study were brain tumor patients from Anhui with limited medical common sense, comparing to social groups in HONG KONG with richer medical knowledge there remains barrier in communicating end-of-life arrangements directly with medical staff. One study demonstrated a-video-based-presentation strategy to solve this barrier which can provide cancer patients a clear perspective of end-of-life care and also can make patients feel secure in their decision, moreover preferences of end-of-life arrangements changed
significantly after video intervention, those participants randomized to watch videos were less likely to choose aggressive care at the end of life.\textsuperscript{14–15} So in the future, there is an intense demand for our medical staff to introduce end-of-life arrangements with multiform-technology to brain tumor patients and other kinds of cancer patients in order to let cancer patients make their real choices. Our study also showed 65.82% participants wanted resuscitation when patients were in a persistent vegetable state (such as brain tumor progression) and there were 41.45% participants wanted life-support. But we confirm multiform-technology presentation would consolidate the particular medical modalites of end-of-life care among brain tumor patients and they would make another decision after comprehending those medical common sense.

### 4.4 Predictors of end of life care

Logistic model shows that compared with participants with brain metastases, participants with brain primary tumor patients were more likely to prefer end-of-life care, which is one of the most important findings that relating to brain tumor illness in our study. And our brain primary tumor patients were mostly consisted by glioma (90.69%), which surgery and radiotherapy after 6 or 8 weeks after operation are recommended to cure,\textsuperscript{16–17} while participants with brain metastases were from lung cancer (44.34%) and breast cancer (49.13%), and these brain metastases patients could have already received surgery, radiotherapy, chemotherapy, targeted therapy or immunotherapy which before brain metastases emergencing and they already understood these treatment goals and potential outcomes, so they were less likely to prefer end-of-life care which can only prolong their life for a few days. End-of-life care is very important in primary brain tumor patients, because these primary brain tumors had a rapid progress and a poor prognosis and more importantly it is relatively severe as soon as it appears, there is no remission period for patients to stabilize their panic usually.

We found the educational qualification of junior or less, new rural cooperative medical insurance (which can cover 50% total medical expenses) and medical expenses paid by their children or spouse were more likely to prefer end-of-life care to prolong their life, this is similar to a study in Taiwan, those who had low socioeconomic status, had metastatic malignant disease, lived in urban areas, or were in hospitals with more abundant health care resources were more likely to receive aggressive end-of-life care to delay death.\textsuperscript{18} And one study in American reported that patients living in low-income zip codes were found to be less likely to receive end-of-life cancer treatment.\textsuperscript{19} In our study, we still found the participants who were older, male, had children were more likely to receive end-of-life care, this may imply that Confucianist still play an important role in our traditional culture.\textsuperscript{20} Promoting the model and content of end-of-life care among the poorer socio-economic groups and the elderly and let them familiar with the results of end-of-life care can bring to themselves are crucial for these people to better understand end-of-life care and make a reasonable choice. Only in this way, the poorer socio-economic groups and the elderly could avoid side effects of excessive medical treatment and it can also prevent families’ members from making wrong decisions for brain tumor patients after they are unconsciousness.

### 4.5 Limitations
There were several limitations in our study. First of all, our study was executed in two hospitals, so there may exist sample bias; Secondly, the participant in our study were brain tumor patients only, in the future other kinds of cancer patients should be included. Furthermore, we should carry on a longitudinal study with technologies (ie, video) in order to eliminate the barrier in communicating advance directives and end-of-life care with patients and find an optimal time for patients to make their true preferences.

4.6 Conclusion

This study illustrated attitudes and preferences toward advance directives and end-of-life care among brain cancer patients. Although advance directives and end-of-life care has not been systematically applied to Chinese brain cancer patients and the knowledge of advance directives is limited, most participants still prefer to achieve their individual value. More efforts should be made for the participants with primary brain tumors, who undergoing surgery and radiotherapy and low socioeconomic status, and an appropriate decision-making timing with a technology-based communication is encouraged in promoting advance directives in Chinese brain tumor patients.

Abbreviations

AD: Advance directives; KPS scores: Karnofsky scores; OR: odds ratio; CI: confidence interval.

Declarations

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Authors’ contributions

Yi Xin Wang, Yong Kang Zhang and Hong Zhi Wang contributed to the conception and design of the study. Yang Hong, Ping Zeng, Zong Tao Hu, Xiu Li Xu assisted for the acquisition and organisation of data and Yi Xin Wang and Yong Kang Zhang in the organisation of the database and data analysis. Yi Xin Wang, Yong Kang Zhang, Hong Zhi Wang contributed in the analysis and interpretation of data and revising the manuscript. All authors read and approved the final manuscript. The first two authors contributed equally to this paper.

Compliance with Ethical Standards

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Competing interests

The authors declare that they have no competing interests.

Ethics approval and consent to participate

The research protocol (SL-KY2020-002) was granted by Cancer hospital, Chinese academy of science, Hefei Ethics Committee. All subjects were informed about the aims of the study and gave written informed consent prior to their participation and the records did not contain information that could identify the participants. This study complied with all ethical guidelines for human experimentation stated in the Helsinki Declaration.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Consent for publication

Not applicable.

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