



Treatment Options for Pediatric Neuroblastoma: A Comprehensive Comparison of Different Treatment Options

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Background

What is Pediatric Neuroblastoma?

- One of the most common cancers seen in infants and children
- Has one of the highest mortality rates when compared to other forms of pediatric cancers
- Begins in the nerve cells
 - Most commonly in the abdomen and the adrenal glands
 - Can be present in the neck or spinal cord
- Has a high chance of metastasis
 - Rapidly spreads to other areas of the body, commonly throughout the nervous system
- Each case of pediatric neuroblastoma develops in different ways, and symptoms vary for each patient
 - Many experience pain and life-long residual issues, along with many neurological issues

(Pediatric Neuroblastoma - Conditions and Treatments, 2020).

Introduction

- Previous research has discussed the effects of different treatment options, including chemotherapy, radiation, medication, and surgical treatment; however, no studies have comprehensively compared different treatment options in terms of treatment-related health complications and success rates
- Many studies do not compare the lifelong effects that each different treatment option has, which can aid in determining which treatment option is best suited for patient survival and patient quality of life both short-term and long-term
- Research is needed to determine if there is a way to treat pediatric neuroblastoma that will not affect the child negatively both short-term and long-term.

Purpose

The current research seeks to review the existing literature on available treatment options for pediatric neuroblastoma (chemotherapy, radiation, medication treatment, and surgical intervention) and to determine which treatment option or combination of options would be best for treating this devastating pediatric cancer. Adverse effects of each type of treatment option are also considered.

Materials

- In each of the following studies, participants were analyzed to determine the effects of their treatment option (i.e., radiation, chemotherapy, surgery, medication) to determine both long-term effects and short-term effects directly related to the progression of the tumor.
- All of the mentioned treatment options analyzed in this study can vary with combination usage.
- Participants falling into different treatment options were analyzed independently to see which treatment of pediatric neuroblastoma is the most successful with the least amount of adverse effects.
- When comparing different forms of treatment that may be considered to treat pediatric neuroblastoma, studies and review of different forms of treatments and their implication have been conducted to determine what may be best for the patient, not only during treatment, but in later years as well.

Results

- Radiation
 - Usage of radiographic endpoints were measured using clinical metrics of renal function, creatinine and blood urea nitrogen (BUN) values. An absolute increase was observed for all patients in serum creatinine and blood urea nitrogen was 0.07 mg/dL and 4.99 mg/dL, respectively (Beckham et al., 2017).
- Surgical Procedures
 - Patients who underwent surgical intervention had a higher overall survival than those who had a biopsy only. There was limited improvement when looking at the estimated survival rates following any surgical intervention (Du et al. 2014). A statistically significant increase in survival through the use of the primary tumor (P=0.02). Unfortunately, surgical intervention was associated with short-term advantage at the 2-year ES of 28.7%.
- Medication
 - The prodrug-loaded nanoparticles (NP) caused a rapid regression of large tumors and significantly delayed tumor regrowth after cessation. The formulation strategy of the NP enabled by a reversible chemical modification of drug molecule achieved intratumoral drug levels, which contributed to both potency and extended duration of antitumor activity (Alferiev et al. 2015).
- Chemotherapy
 - The overall survival rate was 96% (+/- 1%), with 98% of patients who had favorable biologic features having a 3-year survival, and 93% with unfavorable biologic features present in the tumor (Baker et al., 2020).

Discussion

Radiation Therapy

- Leads to increased chance of survival and elimination of the tumor.
- This is due to the radiation therapy killing cancer cells, as well as slowing their growth by damaging their DNA (Robbins et al., 2010).
- Radiation therapy takes a long time in order to see results, so this treatment option needs to begin early on, to then be complemented with other treatment options in the future (Robbins et al., 2010).

Surgical treatment

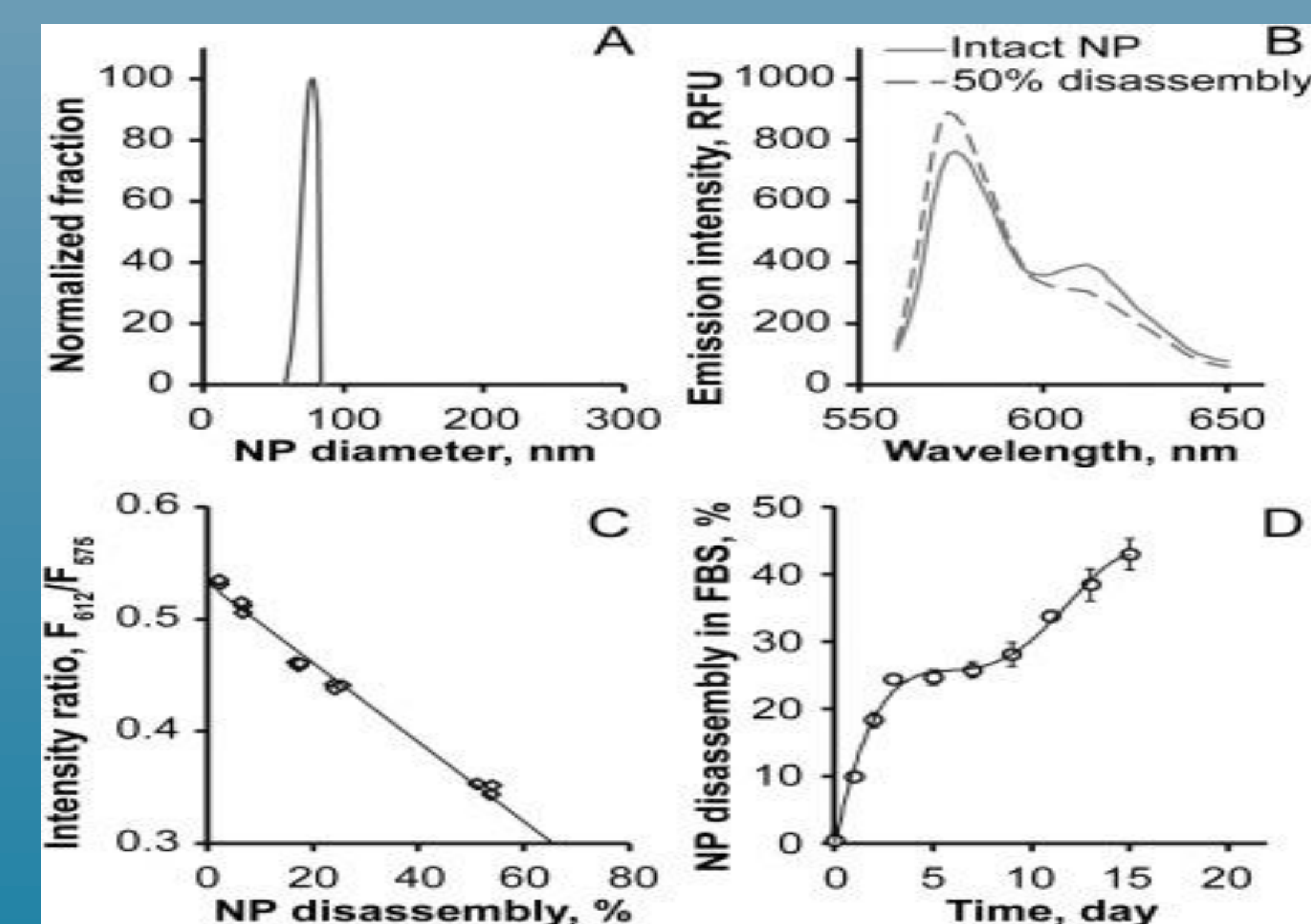
- Patients who receive surgical treatment at later stages were equally as likely to suffer mortality than patients who had no surgical treatment done (Simon et al., 2013).
- Patients who received surgical treatment early, while tumors were small, had a much higher overall survival rate (Strother et al., 2012).
- This was because patients in late stages of neuroblastoma often had the cancer spread through most of their brain and body (Englum et al., 2015).
- Surgical treatment as a sole and only treatment option is only viable if there is an early detection of neuroblastoma; in late stages of neuroblastoma surgical treatment should be avoided (Strother et al., 2012).

Medication

- Dinutuximab and nanomedicine were both proven as effective forms of complementary treatment for neuroblastoma.
- Dinutuximab has been a top tier choice of medicine for high-risk neuroblastoma patients, this medication binds to cell surface GD2 and causes the death of the targeted cells (McGinty et al., 2017).
- Nanotechnology can provide rapid and sensitive detection of cancer-related molecules, enabling scientists to detect molecular changes even when they occur only in a small percentage of cells (Alferiev et al., 2015).
- These treatment options, should not be used as sole treatment options to treat neuroblastoma in pediatric patients.

Chemotherapy

- Chemotherapy treatment is an exceptional treatment option because it prevents cancer cells from growing, dividing, and making more cells (Coburn et al., 2016).
- Chemotherapy uses drugs to destroy cancer cells, but in the process many adverse effects occur, and an overall worse quality of life is reported (Habib et al., 2012).
- This worse quality of life is often why chemotherapy treatment is started when neuroblastoma aggressively spreads throughout the body (Ladenstein et al., 2017).
- Should be used with radiation therapy for best results are seen (Coburn et al., 2016).
- Cycles of high chemotherapy with radiation therapy for 2 to 6 week (Boburn et al., 2016).
- Four to eight cycles needed in order to completely eradicate the spread of neuroblastoma in pediatric patients (Boburn et al., 2016).



Conclusion

- Radiation should almost always be used as a treatment option (Robbins et al., 2010).
- Surgical treatment should be used for early to mid-stages of detection and diagnosis of neuroblastoma (Stoher, 2012).
- Surgical treatment is often paired with other treatment options in later stages (Stoher et al, 2012).
- Medication have been proven to be effective complementary treatment options to chemotherapy, radiation therapy, and surgical treatment (Alferiev et al., 2015).
- These treatment options do not have sufficient data behind them to be used as sole treatment options for pediatric patients with neuroblastoma (McGinty et al., 2017).
- Chemotherapy should be saved for late stages, when cancer begins to aggressively spread throughout the body (Ladenstein et al., 2017).

Recommendations

- Radiation therapy should be used after diagnosis due to how long of a process this treatment option takes to stop the spread and progression of cancer
- Surgical treatment should be used for early to mid-stages of detection and diagnosis of neuroblastoma.
- When tumors are small and have yet to spread and entangle to structures and blood vessels, they are much simpler to surgically resect as opposed to when cancerous tumors spread throughout the brain and body, making it much more difficult to surgically resect.
- If neuroblastoma is diagnosed and detected in mid to late stages, and or aggressive spread of cancer throughout the body is occurring, chemotherapy should be used, it is often saved for when rapid progression and spread for the disease has occurred due to patient's quality of life significantly worsening, as well as the many adverse side effects that come with it.
- Chemotherapy yields best results in combination to radiation therapy; this is because chemotherapy help weaken the spread and progression of cancer cells which helps radiation work better in eradicating them.

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